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Estimation of Haemoglobin Using Optical Sensor Based System

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ABSTRACT: Haemoglobin is the most important parameter in blood cells of human body. Haemoglobin is the protein in red blood cells that carry oxygen to the body. Low level of haemoglobin can be due to disease like anaemia[1]. Invasive methods are mostly used to measure haemoglobin level. These methods involve pricking the blood to needle and sending it to laboratory for further analysis this result in delay and chances of infection. We developed an optical sensor for measurement of the haemoglobin by non-invasively. Now a day's many non invasive techniques such as colour analysis, pulse oximetry and photoplethysmography has been involved that can be used to measure haemoglobin level in blood non-invasively[2]. Our proposed work deals with the utilizing the non invasive technique like photoplethysmography, simple, painless, low cost and easy to operate device to determine haemoglobin in real time.

KEYWORDS: Haemoglobin, Photoplethysmography, IR LED, Red LED, Photodetector and PICMicrocontroller

I. INTRODUCTION

Haemoglobin (Hb) is the most vital component in human blood, and is responsible for transporting oxygen from the lungs to the rest of our body. It is composed of a protein, called globin, and an iron containing compound called heme. Haemoglobin level is an important clinical parameter for assessing anemia in both chronic and acute conditions, If Hb concentration falls below normal, this is called anaemia. Anaemia is to be one of the most serious problem in the world [3].

The invasive method requires painful needle stick to draw a blood sample. Then it is sent to alaboratory for analysis, with results reported back to the physician later, potentially resulting in diagnosis and treatmentdelay[4].A non-invasive method allows pain free continuous on-line patient monitoring with minimum risk of infection and facilitates real time data monitoring allowing immediate clinical reaction to the measured data. It is well known that pulsatile changes of blood volume in tissue can be observed by measuring the transmission or reflection of light through the blood volume. This diagnostic method is known as photoplethysmography (PPG) [5].

This non-invasive optical measurement method is based on radiation of red and near infrared light, emitted by Light Emitting Diodes (LED) in the range of 600nm to 1400nm.The detector detects the light transmitted through the finger. Then it will give the result in real time[6,7].Oximetry, is well known as typical example of a near-infrared application in clinic, and can be used for non-invasive measure the oxygen saturation of human blood in-vivo [12]. A method referred as pulse oximetry empowers non-invasive techniques to exhibit painless and relatively efficient Hb measurement. The necessity for appraisal of Hb count led of non-invasive measurement scheme including imaging[11], spectro-photometry[10], opto-acaustic spectroscopy[8,9], transmission spectroscopy. The absorption of whole blood in the visible and near infrared range is dominated by the different hemoglobin derivatives and the blood plasma that consists mainly of water. It is well known that pulsatile changes of blood volume in tissue can be observed by measuring the transmission or reflection of light through the blood volume. This diagnostic method is known as photoplethysmography (PPG).

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II. BLOCK DIAGRAM

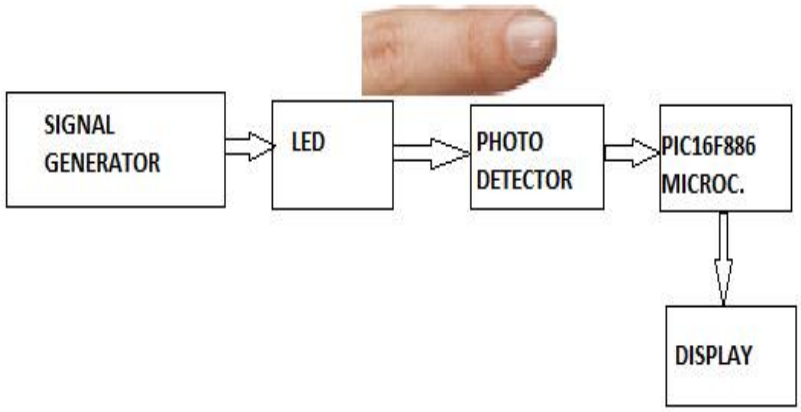

Figure 1 Block Diagram of the system

The device consists of two LEDs of different wavelengths- 660nm and 940nm. These wave lengths areselected in particular because it is at thesewavelengths that the spectral absorptivity ofhaemoglobin and oxy-haemoglobin is considerable.The LEDs are derived with transistor driver circuit.The light form the LED made to pass through thefinger. The light that gets partially transmittedthrough blood is received on a photo diode. Theoutput of the photodiode is sent to PIC microcontroller. PIC microcontroller controls the output of photodetector and ADC converter converts the value of the haemoglobin in digital form. The output of ADC is given to microcontroller for further processing. The out is displayed through LCD display.

III. FLOW DIAGRAM

- Finger will be put on the Red LED , IR LED and Photodetector.
- Red and infrared light is emitted sequentially through the body tissue.
- The transmitted light is reflected from tissue cells and sensed by photodiode.
- Out-put voltage of photodiode increases linearly with light intensity.

A photodetector converts light energy into an electrical current. Near infrared devices can be encased with daylight filters. The photodetector connects to low noise electronic circuitry that includes a trans-impedance amplifier and filtering circuitry. There are two main PPG operational configurations: transmission mode operation where the tissue sample (e.g. finger) is placed between the source and detector, and reflection mode operation where the LED and detector are placed side-by-side. Three channel PPG research systems many of the studies reported in the PPG literature are for a single site, often the ear, finger or toe, where pulses can easily be detected. Multiple finger site pulse data have also been reported by us.

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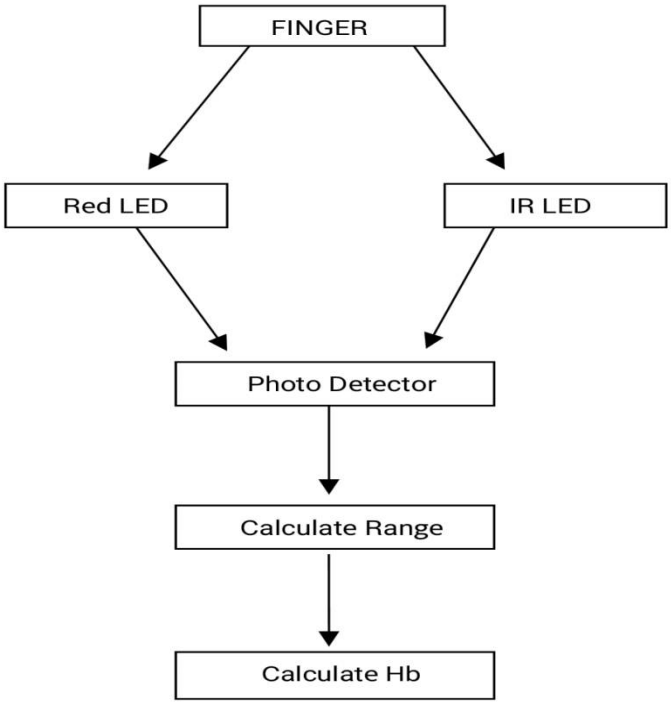

Figure 2 Flow Diagram

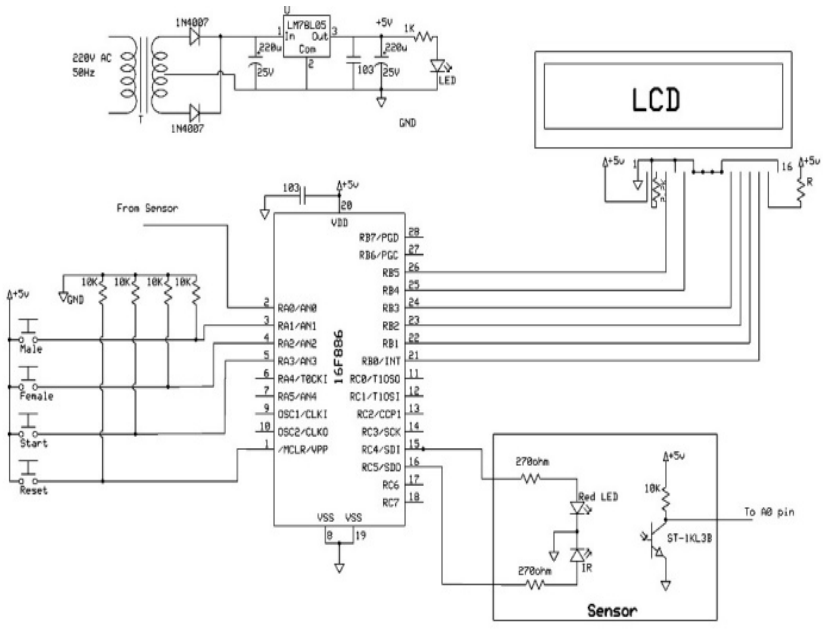

Figure 3 Circuit Diagram

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IV. RESULT

An optical non contact type sensor for haemoglobin measurement is developed. With the help of developed technique it is possible to measure haemoglobin with two wavelengths 660nm and 940nm. Data from 5 volunteers of different ages and with varying Hb levels is acquired using the optical sensor built. . From the result, it can observe that thedifference between invasive and non-invasive is measurement with in a limit. As shown in Table 1.

Table1: Result Comparision

Members	Clinically report	Project report
1.	15.4gm/dl	15gm/dl
2.	14.2gm/dl	14gm/dl
3.	13.6gm/dl	11.9gm/dl
4.	12gm/dl	12.9gm/dl
5.	9.6gm/dl	9gm/dl

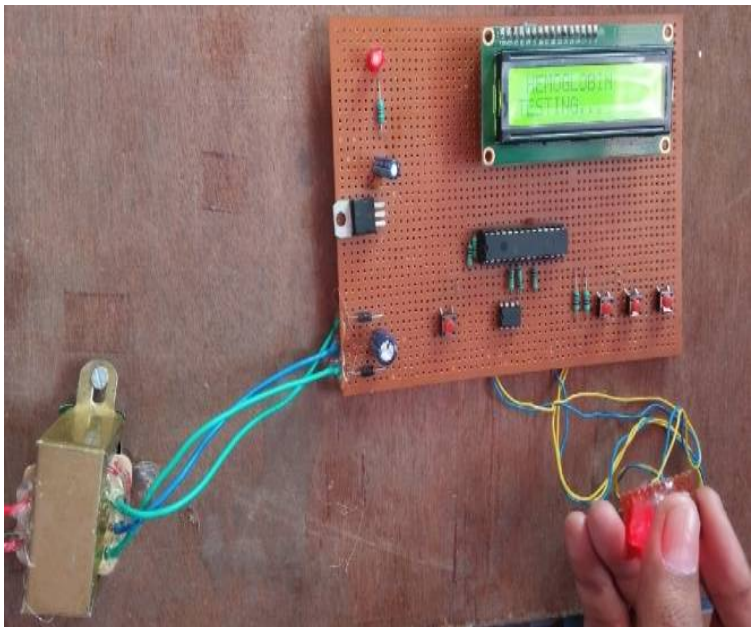

Figure 4 Actual photograph of hardware.

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V. CONCLUSION

The ability to noninvasively measure the haemoglobin levels is a promising advance in technology. It has the potential to decrease medical costs and enable expedient clinical decision-making by reducing the need for costly, time consuming, and potentially painful blood draws that allow only intermittent and delayed measurements .This method is the simplest method with acceptable accuracies. Efforts are being taken by our to develop a hand held instrument that can be utilized to collect the samples for calibration.

VI. FUTURE SCOPE

Hb sensor developed by us can be fully integrated into a wearable fingerclip.

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